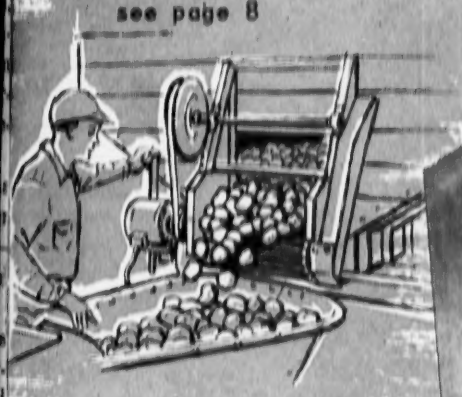
AGRICULTURAL Research

JULY 1956



HOW FAST?
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HOW MUCH?
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HOW GOOD?
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UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL
Research

Vol. 5—July 1956—No. 1

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Keeping Up

When farm prices are low in relation to production costs, good soil management becomes more necessary than ever.

Fortunately, science continues to turn up new facts to help farmers make their work and dollars count for greatest returns. Take these examples from research that's in progress:

Cutting down on tillage operations offers possibilities for savings. In Wisconsin and elsewhere, corn that was planted right behind the plow has produced as much or more than corn planted in the usual pulverized seedbed. Minimum tillage also reduces soil compaction, enabling the soil to take in more water and take it faster—and thus resist erosion better.

Parallel terraces promise savings by cutting down the turning of field equipment. On many soils and slopes, most of the point rows can be eliminated. In Missouri, parallel terraces cut the time of planting and cultivating corn by one-fifth.

Dryland farmers may find wheat stubble is worth more than they thought. In Idaho research, much less seed wheat is required to get a good stand where stubble is properly used.

In an irrigated area of Montana, research is showing farmers how to increase their efficiency by using more fertilizer of the right kinds in combination with improved irrigation practices that save water. Nebraska farmers who used to irrigate field beans once a week now produce as much with only 2 or 3 irrigations a season when those are scentifically timed.

In Alabama last year, Sudan grass that was fertilized with plenty of nitrogen took only half as much water per pound of dry matter as did unfertilized Sudan grass. Studies in Mississippi and Louisiana show that breaking hardpan layers increases the storage of moisture in subsoil during dry years.

North Carolina farmers who want to know whether it will pay to buy irrigation equipment, or how often they may have to use it, are getting help from studies of drought frequency.

In times like these, there's always some tendency to cut costs by neglecting the soil or otherwise sacrificing good practices. But that leads only to more trouble. The desirable way to cut costs is to use improved practices as they are perfected. Modern conservation methods are efficient methods.

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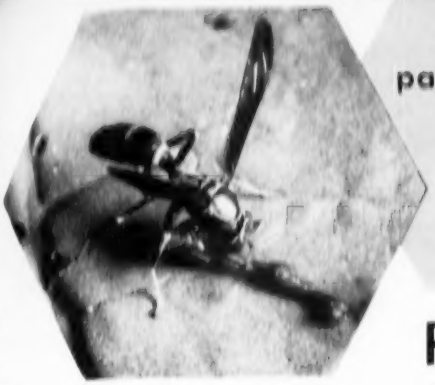


WASP, having killed its hornworm victim, prepares a pellet from the carcass. The wasp pictured killed 10 hornworms in about 7 hours and carried away 18 pellets. (Large spot of white paint on right side of thorax marks this individual.)

As every farm boy knows, wasps are equipped with highly effective stingers. But these stingers are not used in attacking hornworms or budworms.

A hunting wasp flies slowly among tobacco plants in search of prey. When an intended victim is found, the wasp may alight and casually walk into battle. Or he may attack Stuka-like by power dives.

Usually a wasp selects a small or medium-sized worm. But when worms are scarce, he'll valiantly attack any hornworm or budworm he sees. The attack usually ends in the death of the worm.

Wasps kill by repeatedly biting their prey with their razor-sharp mandibles. Frequently the wasps sink their mandibles into the back or side of a hornworm and hold on with jaws and feet as the worm threshes from side to side in an attempt to dislodge his enemy. Slashing bites may make the worm bleed to death.

Once a kill is made, the wasp feeds on some of the remaining blood and body juices. Then it dissects the carcass—even to removal, with surgeon-like precision, of intestines, head, and two hard plates found on either side of a large hornworm. When the butchering is completed, the wasp rolls the meat into pellets and flies them home, one by one, for the brood.

This stinging, paperhanging killer is the

crops and soils

Tobacco Farmer's Friend

RESEARCH is seeking a way to make the wasp *Polistes exclamans* and other members of his group more useful allies of tobacco farmers.

Long known to entomologists as natural enemies of tobacco hornworms, budworms, and other pests, the insects commonly called paperhanger wasps seek prey on tobacco plants.

Entomologists believe that the simple expedient of providing suitable shelters can encourage the buildup of wasp populations so that they will aid farmers more materially in reducing hornworm and budworm numbers. USDA-State experiments conducted since 1952 at Oxford, N. C., have indicated considerable value for this form of biological control.

The building of shelters in likely spots was conceived by ARS entomologist F. R. Lawson. His idea makes use of the fact that wasps don't live in tobacco fields, which afford little protection against enemies or elements, but rather in bordering grass, brush, or wooded areas.

Entomologists don't yet know whether predatory wasps alone can be depended on to control hornworms and budworms. Experiments and observations indicate, however, that at least in moderate infestations, a sizable wasp population can be a valuable asset to a tobacco farmer.

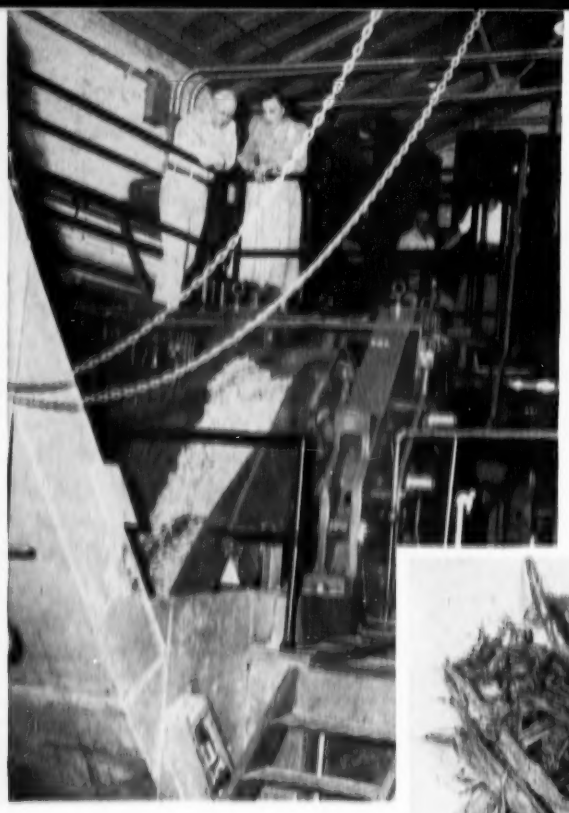
Conceivably, this type of biological control could, under some circumstances, eliminate or reduce the need for applying insecticides. This would not only cut down the expense of treating tobacco fields with insecticides but might also prevent the overuse of chemicals—a practice that sometimes leaves excessive quantities of residues on the valuable tobacco leaves.

Tobacco hornworms, prevalent in the South, and tomato hornworms, found chiefly in the North, feed on the leaves of tobacco and tomato plants. With each tobacco leaf worth an average of about 1 cent to a farmer, the extent of damage can easily be imagined. Observation has shown that with a population of only 2 hornworms to 50 plants, damage may amount to 500 leaves an acre.

The Federal-State efforts, conducted by Lawson in cooperation with R. L. Rabb of North Carolina State College, at Raleigh, have served to point up the value of wasps of the *Polistes* family in hornworm control. To a lesser degree, the scientists have also observed fair control of budworms by the same means.

Further study will be needed, of course, before the full value of these helpful wasps even as a supplemental control measure can be determined, or their use recommended.☆

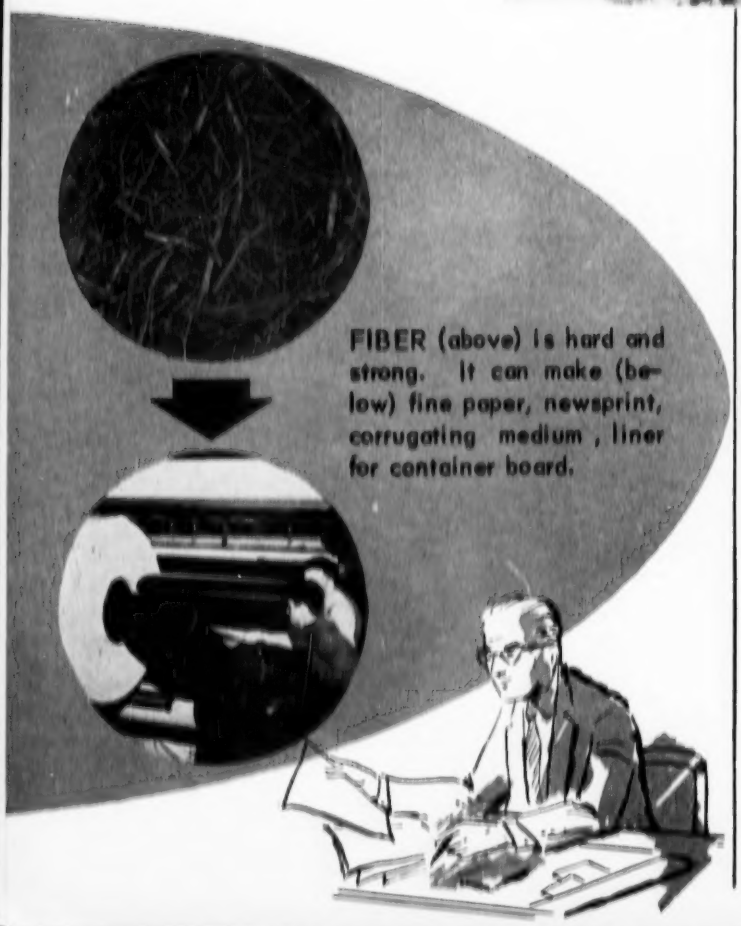
SHELTER is a long, narrow box, constructed of rough boards, with a side or end left open and covered with chicken wire to protect wasps from birds or other predators. This makes an ideal place in which these beneficial insects can build multicelled nests of paper of their own making. Shelters are fastened to posts, usually with the open side facing the ground.



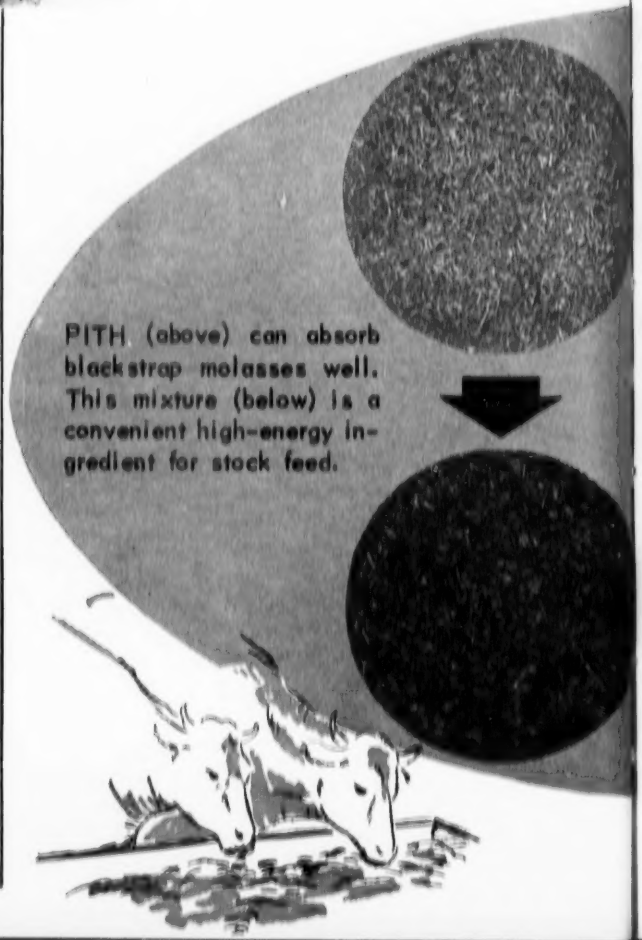
Bagasse GETS A FUTURE

Research is showing new possibilities in our big supply of sugarcane residue

BAGASSE, the residue left after pressing juice from sugarcane, is pictured as it comes from the rolls of Audubon Sugar Mill, of Louisiana State University. Once largely burned, bagasse is getting increased use for poultry litter as well as for stock feed and paper products. ARS utilization researchers have aided the trend by devising practical ways of separating the pith and fiber.



FIBER (above) is hard and strong. It can make (below) fine paper, newsprint, corrugating medium, liner for container board.



PITH (above) can absorb blackstrap molasses well. This mixture (below) is a convenient high-energy ingredient for stock feed.

BAGASSE—the fibrous residue of sugarcane that remains after crushing the stalks for juice—may soon have as much commercial utility tonnagewise as the sugar obtained from the cane. Through processes developed at USDA's Northern Utilization Research Branch, Peoria, Ill., unbleached or bleached pulps suitable for corrugated boxboard, newsprint, and fine papers can be manufactured economically from whole bagasse or, better, from pith-free bagasse fiber.

Worldwide, the supply of bagasse is immense. For every pound of sugar produced, more than a pound of bagasse accumulates. Since it takes almost 50 billion pounds of sugar to help satisfy the world's sweet tooth, more than 50 billion pounds of bagasse are available for a variety of industrial applications. Until recent years, its full potential value had not begun to be realized. For the most part, bagasse was destroyed by burning in sugar-mill boilers, even in excess of the fuel needs.

Two main kinds of tissue make up bagasse—hard, strong fibers that form the outer covering and support of the cane, and pith cells that contain the sugar juices. These pith cells lack fibrous structure and strength; they should be removed for most effective utilization of the fiber.

Turning bagasse into paper has long been possible. But older ways of separating pith were impractical, and destructive of the fiber. So it was economically and technologically impossible for bagasse paper to compete with the wood-pulp product.

Now, principles of the mechanochemical process (AGR. RES., July 1954, p. 7) have been applied along with highly practical methods developed and tested on a commercial scale by ARS researchers to separate pith from bagasse fiber. So it's possible to prepare greater yields of high-quality bagasse pulps at lower costs.

Potential availability of bagasse papers made possible by this work should have far-reaching effects in improving social and economic conditions in less-developed countries.

Extended semicommercial-scale studies were recently completed under USDA contract at the New York State College of Forestry, Syracuse. These showed that fine bleached papers and newsprint, as well as superior corrugating medium and liner for container boards, can be made from depithed bagasse pulped by the mechanochemical process, and also from blends of depithed bagasse pulp and kraft wood pulp. The practical use of both bagasse and wheat straw for newsprint manufacture was demonstrated when experimental newsprint comprising 30 percent bagasse or straw pulp and 70 percent groundwood pulp was used successfully in printing a portion of the Peoria Journal in December 1954.

Several types of papers from bagasse pulped by the mechanochemical process have been produced at Peoria in cooperation with the U. S. Forest Products Laboratory, Madison, Wis. As far as physical properties are concerned, these pulps are stronger in all but tearing resistance than softwood pulps produced by the acid sulfite process. The pulps are particularly suitable for blending with wood pulps to make a wide variety of fine papers as well as newsprint.

In Louisiana and Florida, where the 900,000 tons of United States bagasse are produced annually, some of the bagasse is processed into poultry litter. This business is more profitable than burning the bagasse and is increasing in volume yearly. The potential market for bagasse litter is indicated by the 13.3 million tons of all types of litters used in the United States in 1952.

Potential industrial usefulness of bagasse was increased when the Northern Branch developed practical ways of removing pith from fiber. Commercial-scale trials of one method indicate that these procedures are entirely feasible for operation at sugar mills. Commercial application of these methods for separation of pith and fiber would not only improve the present use of bagasse but should also lead to expanded utilization of bagasse now being wasted.

Sugar extraction yields another byproduct—blackstrap molasses, the sirupy residue of sugarcane juice left after extraction. Our potential market for molasses as feed is estimated at nearly a billion gallons a year.

One of the most promising methods for using pith is to take advantage of its high absorption value for blackstrap molasses—more than three times higher than for many common absorbents—and use the pith as a dry-form molasses carrier. More than 70 percent of our blackstrap can be mixed with pith to produce a solid, easily transportable, high-energy ingredient that livestock relish.

If the sugar industry itself undertook the recovery, maximum profit from these byproducts would result. The sugar mills could separate the pith and fiber, sell the fiber to paper mills, and combine the dried pith with blackstrap molasses to make an ingredient for livestock feeds. By proper use, these byproducts could be a factor in offsetting operating costs.

Our commercial exploitation of bagasse is already being expanded. In addition to making insulating boards and plastics compounds from bagasse in Louisiana, a paper mill is producing 20,000 to 25,000 tons of bleached papers annually from whole bagasse. Good opportunity remains for developing new and expanded industrial outlets because less than 40 percent of the Louisiana production (700,000 tons) is being utilized to best advantage as a raw material.☆

WE'RE AHEAD OF Oat Diseases

Resistant varieties developed by plant breeders are paying good returns

RESEARCH has won a nip-and-tuck race against oat diseases that threatened disaster to growers at least 3 times in the past 20 years.

Whether this victory is lasting or not, it has meant to growers more than a billion dollars in added returns at a total cost of slightly more than $3 million for research—that's $1,000 for every $3 expended.

Out of this USDA-State research program have come new varieties of oats that resist diseases, better quality oats to meet our demands for food and feed, and high-yielding oats to reduce the cost of production.

Summed up, these research efforts have made possible a yield of 38.5 bushels of oats per acre in 1955 and a total harvest of 1,576 million bushels—new all-time records.

Today, science is out in front in this race with disease. How long can it keep the lead? No one knows, of course, and scientists point out that nature never takes a holiday.

Development of disease-resistant varieties was and still is the major problem in oats, says ARS pathologist H. C. Murphy, who directs the national program from Ames, Iowa. Twenty-five years ago, with research in oat breeding barely started, North Central States growers were planting varieties mainly derived from pure line selections of Kherson and Sixty Day. In the South, Red Rustproof, Fulghum, and Lee were commonly used.

In all areas these varieties were hit hard by rusts and smuts. Test weights rarely exceeded 34 pounds a bushel in good years and 20 pounds or less when rusts were severe.

Inroads of crown rust and smut were largely responsible for knocking out susceptible Kherson and other varieties between 1941 and 1943 when production fell far below average.

Plant breeders, however, were ready with new varieties—Victoria strains—resistant to these infections. By 1945 about 90 percent of the North Central States oat acreage and 75 percent of our total acreage were planted to these derivatives.

Despite light damage from races 8 and 10 of stem rust, these varieties produced record yields until the Victoria blight struck in Iowa in 1946 and 1947. The disease spread to all oat-growing areas in 1947 and 1948 and forced Victoria strains out of the picture faster than they came in. Bond strains, resistant to the blight and to many races of crown rust, appeared in 1946. By 1948 these strains had reached a peak of popularity through their disease resistance, high yields, and stiff straw.

Bond strains, however, are now being hit by race 7 of stem rust and by race 202 and similar races of crown rust. For this reason, new resistant strains are beginning to take over and will help prevent disaster from striking. Among them are derivatives from Landhafer. Santa Fe, Hajira-Joanette and others. Many are resistant to all races of stem rust and smut and to all prevalent races of crown rust as well as several minor diseases. They are high-yielding and have stiff straw to permit more efficient combine harvesting.

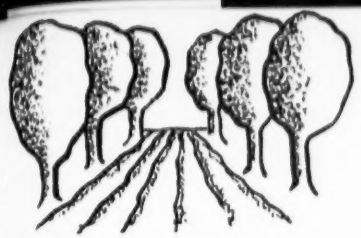
About 80 percent of our oat crop is produced in the 12 North Central States. Of this total, about half is grown in Iowa, Minnesota, Illinois, and Wisconsin—Iowa leading with some 6 million acres a year.

Oat production in the southern States has increased strikingly in the last few years. In 10 years the acreage in the South has nearly doubled, thanks to development of disease-resistant and more hardy new varieties that make fall sowing possible. Thirteen Southern States are now approaching 10 million acres in oats annually from an average of 5,147,000 acres in the 1935–44 period.

At least 90 percent of the country's total acreage last year was planted to high-yielding, high-test-weight, stiff-strawed, and smut-resistant Bond derivatives. Landhafer and other derivatives making up most of the remaining acreage possess these same characteristics. More important, they have rust and disease resistance that Bond derivatives lack.

Because of widespread use of the Bond and new derivatives last year, more than 90 percent of the oats marketed in the North Central States graded No. 1, heavy, or extra heavy, against 80 percent grading No. 3 or lower in 1936. Yields for the 5-year period ended in 1955 were just short of 35 bushels an acre—up 42 percent from the 24.5-bushel yield for the 1932–36 5-year period.

Growers in major producing States and all others where oats are grown extensively have found the 20-year program worth the price. Oats constitute a highly important grain feed crop, second only to corn. Severe losses are the rule when diseases such as rusts, smut, Helminthosporium, and Septoria take over. Diseases have done this in the past. But they are less likely to do it again soon. Research is keeping up with disease developments—even ahead of them—with new oat varieties that provide disease resistance and can yield heavily of high-quality grain.☆



Windbreaks take tough trees

THREE SPECIES SURVIVED A LONG-TIME GREAT PLAINS TEST THAT ALSO COVERED SPACING, CULTIVATION, PRUNING

ONLY 3 species of trees met the test of hardiness for farm windbreaks in the Northern Great Plains' severe climate in 38 years of testing by USDA at Mandan, N. Dak., Ardmore, S. Dak., and Moccasin, Mont. Proper spacing, clean cultivation, and little or no pruning were other conditions that proved successful.

Boxelder, green ash, and the shrubby silver buffaloberry were successful species. The former two have made an exceedingly good record to date—close to 100-percent survival and good growth. Silver buffaloberry, only practical species for good bottom protection against wind, did quite well when planted 12 feet from the nearest row of tall trees but rather poorly in all closer rows.

Brittle willow, Daphne willow, northwest poplar, and Amur maple, other species tested, are too susceptible to drought. The severe droughts of the mid-1930's took a heavy toll of these trees throughout the area.

After 36 years, boxelder attained heights of 14 to 26 feet and green ash 17 to 26 feet. Silver buffaloberry ranged from 5.4 to 9.6 feet at that age, depending on closeness of spacing. Having adjacent rows of tall trees growing closer than 8 feet from them depressed the growth some. Northwest poplar and Daphne willow didn't survive to the 25th year.

ARS silviculturist E. J. George found that adequate spacing is the most important requirement of the hardy species. A spacing of 4 feet in the row and 12 feet between rows was about minimum for success with any of the trees, and 8 by 8 feet was usually better between the tall species. Greater spacing between rows than within the row was best for wind protection. It was difficult to keep down grass and weeds between rows that were over 12 feet apart.

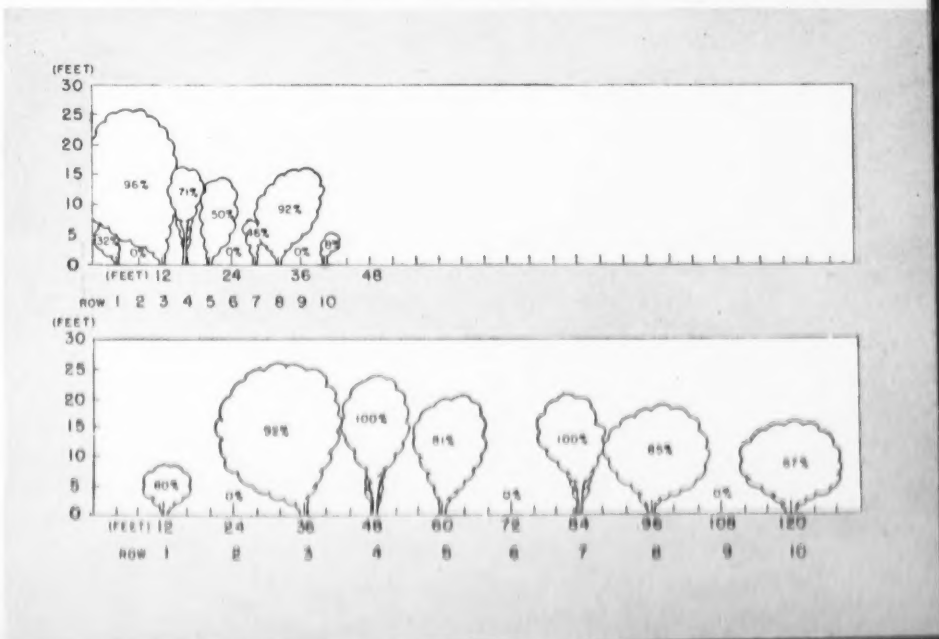
Boxelder and green ash both have survived exceedingly well to date, although a substantial number of silver ash in the 4-by-4-foot planting died after the 13th year. Brittle willow survived rather well in 3 plots for 16 years but the stand declined steadily in the years that followed.

Using preferred species, best growth and survival were obtained by growing the boxelder, a spreading type, in the center rows, flanked by the more upright green ash on either side and silver buffaloberry at the outside. The fast-growing and spreading boxelder or brittle willow will overtop and depress silver buffaloberry if grown next to it and at a distance of less than 12 feet.

The best windbreak was obtained in the unpruned plots, although in some instances the pruned trees and shrubs survived a little better. George advocates a compromise—pruning interior rows of trees to a main trunk and retaining all side branches. But branches should be left on the shrub species in the outer rows to reduce wind near the ground.

This experiment and a study of several thousand farm shelterbelts in the Northern Great Plains showed it pays to keep down competitive weeds and grass by cultivation so long as it's practical to work between the trees or until the trees shade out the undergrowth. Mulches proved undesirable—caused shallow rooting of the trees, introduced weed and grass seeds, and soaked up most of the water from light rains and withheld it from the trees. Plots neglected after the second year of cultivation survived and grew better than mulched plots and sometimes better than cultivated ones. The silver buffaloberry, in fact, did decidedly better without either cultivation or mulching.☆

SPACING TREES 4 feet in row gives windbreak a compact front against prevailing wind if rows are far enough apart (12 feet, as in lower diagram) to grow and survive. Crowding rows to 4 feet apart (upper diagram) distorts or chokes out weak trees. Note survival percentages.



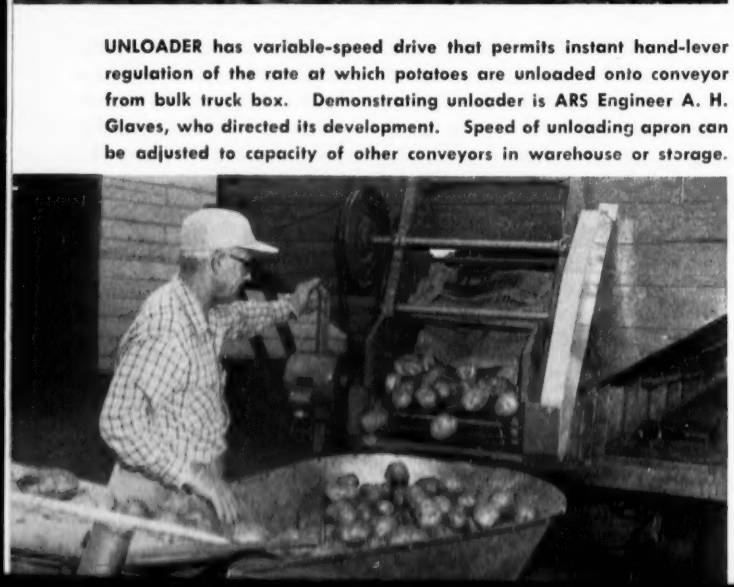
fruits and vegetables

Mechanizing OUR POTATO HARVES

WINDROWER on the back of this two-row digger places potatoes in single windrow. Potato Research Center engineers devised windrower.

HARVESTER (two-row direct types) can cover 10 to 12 acres a day. But in this cloddy field, eight women were needed to supplement the mechanical separation. Researchers are working on that problem. The capacity of 2-row harvesters like this runs from 2,000 to 5,000 bushels a day. This wide range depends on such factors as soil type, moisture, and temperature; freedom from stones; cleanness of cultivation; amount and condition of vine growth; variety; tuber maturity.

UNLOADER has variable-speed drive that permits instant hand-lever regulation of the rate at which potatoes are unloaded onto conveyor from bulk truck box. Demonstrating unloader is ARS Engineer A. H. Glaves, who directed its development. Speed of unloading apron can be adjusted to capacity of other conveyors in warehouse or storage.



Growers, researchers, and industry are cooperating in an effort to develop more efficient equipment for the job

A GREAT DEAL of credit for achievements in mech nizing our potato harvesting should go to a tea of growers, USDA and State experts, and industry.

In little more than a decade, this cooperative team fort has brought potato harvesting from a purely han labor operation to a point where machines probab handle half our crop. A crew of 10 to 15, using a m chanical harvester and companion equipment for ha dling potatoes in bulk trucks from field to storage, c harvest, haul, and store 2,000 to 5,000 bushels of potato in an 8-hour day. Furthermore, the job no longer quires heavy labor. Women handle any of the duti

A monument to this shared interest in mechanization the Potato Research Center—stands at East Grand For Minn., in the rich Red River Valley that straddles t Minnesota-North Dakota border. Here, land and buil ings have been furnished by a local association of pot growers. The Center is staffed by ARS engineers who wo on harvest mechanization; by AMS engineers concern with improving the bulk handling and storage of potato and by AMS biological scientists who measure quali maintenance or damage losses as the crop passes throu each handling step on its way to market. Since it w established 7 years ago, the Center has received on lo from industry nearly $13,000 worth of machinery.

Nor does the team effort end here. Harvester mod cations of inventive growers supply inspiration. Liais among these growers, machine-shop operators, and dustrial engineers is provided by ARS engineers. Th study potato harvesting the country over, determining

BLADELESS POTATO DIGGER developed at Potato Research Center has experimental rod-weeder attachment (left) substituted for original blade. Turning forward and upward through soil, rod breaks up most of large clods and deposits potatoes on apron. (Often aprons are rubber covered to diminish bruising; under certain moisture conditions, natural accumulation of moist, heavy soil provides a self-renewing protection.) Digger fitted with standard blade was used for one windrow (center). Excessive clods will mean much work for crew on indirect harvester that will move the potatoes from windrow to truck. Use of bladeless digger (right) resulted in fewer large clods. This windrow can be picked up with much less trash to interfere with the operation and with less hand labor for separating potatoes from clods and vines.

needs of different regions and observing and evaluating experimental equipment. One of their machine modifications may be shipped to Florida or California for a tryout with the early-spring crop, then be returned to the Center in time for fall harvest. Key man for ARS on the team is A. H. Glaves, who directs harvesting-machinery research at East Grand Forks. Here are some of the mechanization improvements that have come from the Center:

● Newest is the *bladeless digger*—a horizontal rotating rod fitted on digger or harvester in place of the normal digging blade. The rod lifts the potatoes from soil or windrow onto the harvester conveyor apron. On the basis of its outstanding performance in trials at the Center last fall, the rod digger is already under field test by two machinery manufacturers. It does a good job under a variety of soil conditions, can pick up potatoes from the windrow as well as dig them, and causes little spillout loss beyond the edges of the harvester conveyor apron.

● *Windrower* for 2-row potato digger, combining 2 rows of potatoes into a single row for easy pickup by hand or machine, is now in general use on several makes of diggers. Bruising caused by the conveyor system was reduced by tilting the *cross-conveyor aprons*, which move potatoes across the back of the windrower to make 1 row out of 2. Potatoes now drop directly onto the rubber-covered conveyor and not on the other potatoes, which have rolled out of the way because of the tilt of the conveyor.

● *Windrow retainer plates*, which led to the success of indirect harvesting (machine pickup from a windrow), have given 2-row capacity to a 1-row indirect harvester.

● *Tilted-cross-conveyor separation* (clod elimination) has increased the degree of mechanical separation of clods and potatoes. Tilted cross conveyors are now in use on one or more of the models of each of the four popular commercial harvesters used in the Red River Valley.

● Developed in cooperation with AMS, a *vertical potato elevator* that has proved useful in handling potatoes in storage appears to have application to harvester design.

● *Variable-pitch sprockets* for driving digger and harvester conveyor aprons are becoming widely used. They can increase the useful life of aprons 20 to 30 percent. They also provide harvester versatility, accommodating alternate aprons of different pitch and different rod coverings to meet varying field requirements, such as a change from very dry to wet, sticky soil conditions.

● *Variable-speed-drive unloader*, which allows for regulation of the flow of potatoes from truck to receiving conveyor at the warehouse, has been devised by the engineers. This shows promise of early acceptance.

Yet, despite these and other developments that have cut harvesting labor requirements by as much as 50 percent, our big mechanization problem remains the gentle but effective separation of potatoes from vines, weeds, clods, and stones. Under good field conditions, only 1 to 3 extra harvest crew members are needed to supplement mechanical separation by picking trash from potatoes. But if conditions are severe, as many as 10 or 12 extra crew members may be needed. These extra hands are the target of the cooperative team. The engineers hope—through research—to eliminate need for hand labor. ☆

Potatoes are off-flavor when Lindane lingers

■ LINDANE, one of the more important new insecticides, may well affect the flavor, taste, and odor of some crops even a number of years after its application, USDA research shows.

Off-flavor effects were noticed in 3 of the 5 varieties of potatoes grown in fields used the previous year for growing cucumbers that had been treated with lindane. Definite off-flavor was noticed in the Irish Cobbler, Bliss Triumph, and Pontiac potatoes. No appreciable off-flavor was detected in Cherokee and Sebago.

Potatoes stored 3 months at 55° F. after harvest showed off-flavor in the same varieties, but their off-flavor was not increased by storage.

Lindane has been widely used throughout the Southeast as a foliage application on cucumber plantings to control pickleworm and other insects, without complaints of off-flavor. Off-flavors were noticed in other food crops, however, especially potatoes that were grown the following season in the same plot of ground.

ARS food specialists were asked to determine, on the basis of taste judgments, if potatoes thus grown were affected, how much they were affected, and whether storage increased off-flavor. Mary E. Kirkpatrick headed the taste study and was aided by three other food researchers.

Potatoes used in the palatability tests were taken from field experiments that were carried out by ARS entomologists at Charleston, S. C.

Eight weekly applications of either a 1-percent lindane dust or a spray composed of 1 pound of a 25-percent lindane powder to 100 gallons of water were made on cucumbers. Adequate pickleworm control resulted from the lindane treatment, which totaled 1¼ pounds per acre. The following spring, five varieties of potatoes were grown on the same plots. An untreated field of control samples was located 50 yards from the treated plot. Potatoes were generally harvested at three weekly intervals to see if insecticide treatment effects varied with maturity of potatoes.

Laboratory staff members selected uniform potatoes from all varieties, cooked and mashed them under standardized test conditions. Palatability judging was done by other members of the foods staff, trained to recognize characteristic natural odors and flavors as well as off-odors and off-flavors in a variety of foods grown in insecticide-treated soils.

Mature and immature Bliss Triumph and Irish Cobbler, and immature Pontiac made lowest flavor scores. Judges said 28 to 30 percent of the samples had a musty flavor.

Flavor scores for immature tubers of the treated samples were somewhat lower than for those more mature. But drought conditions during growth and the short time intervals between harvest dates make flavor differences based on maturity more of a trend than an established fact.

Previous research elsewhere showed that soil applications of lindane affect the flavor of other food crops in varying degrees. Furthermore, soil application on root crops results in even greater increase in off-flavor than foliage application.

These findings emphasize that lindane should not be applied to soils in which potatoes are to be grown. ☆

OUR ALL-OUT COUNTERATTACK ON THE MEDFLY

■ THE MEDFLY (Mediterranean fruit fly), one of the world's worst fruit pests, reappeared in Florida last April and USDA has instituted an all-out quarantine and eradication program in cooperation with the State.

Fruits, vegetables, other garden and orchard products of all kinds, soil, or other articles likely to harbor the pest can't be shipped out of the regulated area without approval. This calls for inspection, treatment of the materials, or determination that they weren't exposed to the Medfly. The State Plant Board regulates intrastate shipments.

This tropical fly invaded central Florida in 1929 but was soon wiped out by an intensive Federal-State eradication campaign. We have since enjoyed 26 Medfly-free years.

The Medfly punctures fruit's skin to lay eggs, and the larvae that hatch feed inside the fruit. There's danger of shipping the pest out with the fruit, so fruits from infested areas are treated or specially handled so they may be shipped with safety. Wherever this insect shows up, the entire area is sprayed with insecticides containing a protein bait that attracts Medflies.

Trained ARS inspectors regularly check 3,500 baited traps throughout and beyond the infested area so they will know where the Medflies are.

Due to the readiness of ARS and the State to act promptly and decisively, there appears to be a good prospect of eradicating this costly pest. ☆

TEST MEALS for UCLA coeds included muffin or pudding, peanut protein, vitamins and minerals in capsules, fruits and soft drinks for flavor, and sweets and fats for extra needed calories. Girls drank the amino acids dissolved in water.

Essential AMINO ACIDS HOW MUCH OF EACH?

Dietary experiments gave us new information on the body's requirements for these important substances

BASIC information on human requirements for amino acids—substances that are present in all living cells and must be in our food each day—is being provided by research.

Amino acids combine to make protein; different combinations form different proteins, such as casein, zein, and albumen. Amino acids are required for building new body tissue during growth, for renewing and rebuilding tissues at all times, and for forming enzymes and hormones. Some amino acids can be made in the body, but at least eight must be supplied ready made in food. These eight are called "essential" amino acids. If any essential amino acid is lacking or in short supply, the body cannot make necessary proteins.

Nutritionists, dietitians, and physicians need to know how much the body requires of each amino acid as well as which foods supply them. This information is especially important when people depend to a large extent on plant proteins, which are low in some essential amino acids.

ARS nutritionists have been studying the quantity and availability of amino acids in foods (AGR. RES., Sept. 1953, p. 3; Mar. 1954, p. 6) but needed more information on human requirements. Accordingly, USDA contracted with the University of Nebraska to determine young women's requirements for the essential amino acids threonine, valine, tryptophan, phenylalanine, and leucine; and with the University of California at Los Angeles to determine young women's requirements for isoleucine and the sulfur-containing essential amino acids cystine and methionine.

Nebraska researcher Ruth M. Leverton and associates worked with college girls who volunteered to be subjects. The scientists fed the girls synthetic diets containing all the nutrients known to be needed for good nutrition and varied the amount of the particular amino acid under study.

The test diets consisted of cornstarch, sugar, fat, vitamins, and minerals. Added to this ration were the amino acids in pure form, dissolved in distilled water. For 6 to 8 weeks the girls lived on this chemical diet plus small amounts of fruits or vegetables to make the meals more palatable. Samples of all foods and chemicals eaten by the girls were analyzed for nitrogen; urine and feces collected during the entire period of study were analyzed also.

Since all amino acids contain nitrogen, the balance between the amount of nitrogen eaten and the amount excreted indicated whether a girl's requirement for an amino acid was being met. The girls were considered to be in nitrogen equilibrium when the amount they ate was about the same as the amount they excreted; in positive balance when they ate

more than they excreted; and in negative balance when they excreted more than they ate. Nitrogen balance is negative when not enough of any one of the essential amino acids is eaten to meet the body's needs. Then the body draws on its own reserves and tissues to supply the needed amino acids, and the nitrogen released by the tissue breakdown is excreted.

Marian E. Swendseid and associates in California used the same plan for their experiments except for some adjustment in the test diet.

On the basis of the Nebraska tests, Leverton has suggested 310 mg. of threonine as the minimum daily requirement of young women; 650 mg. of valine; 160 mg. of tryptophan; 620 mg. of leucine; and 220 mg. of phenylalanine when the diet supplies 900 mg. of tyrosine. Researcher Swendseid found that 5 girls had cystine-methionine requirements of 350 mg. or less, 2 of 450 mg., and 1 of 550 mg. The requirement for isoleucine ranged from 250 to 450 mg. per day. These requirements are lower than those suggested by other researchers for young men. These data obtained from amino-acid-requirement studies will guide nutritionists in their recommendations for adequate diets.

None of these essential amino acids is likely to be short in an ordinary diet of mixed foods including meat, milk, or eggs. But a diet made up largely of plant proteins will have to be chosen with considerable care.

Even with these data, our information is far from complete. Much more needs to be known about interrelationships among amino acids and between amino acids and other nutrients, and about the rate at which the body makes other amino acids, and their value. Some factors that may affect amino-acid requirement also need study—such as the amount of nitrogen and combination of amino acids eaten, and the age, sex, and state of health of the individual.☆

Tree for Today

■ A SMALL, GRACEFUL TREE of considerable merit for the street or lawn—introduced into this country from Japan by USDA plant explorers more than half a century ago—is still languishing for lack of takers.

The tree, Yeddo hornbeam (*Carpinus tschonoskii*), is adapted to the humid East from southern New York southward. Boundaries of its adaptation have not been determined. It is tolerant of many soils.

According to ARS horticulturist H. H. Fisher, Yeddo hornbeam meets an important need for urban landscaping—it's relatively small (rarely over 30 feet high), has a compact head that doesn't spread far into the street or intrude into utility wires. The upreaching branches lend an illusion of tallness and slenderness. It takes on an attractive reddish-bronze color in the fall. Best of all, it has no important faults.

This is one of a series of tree introductions being recommended as street and park trees to solve the problems of high maintenance cost of taller trees used in the past. The maturity of plantings made in many of our cities has reached the point that maintenance is becoming difficult and many trees are now being replaced. The popularity of the low, ranch-type house also calls for lower, compacter trees.

Nurserymen who are willing to make a limited start with the tree can obtain seeds from USDA's Plant Introduction Station, Glenn Dale, Md. After they are acquainted with this tree, nurserymen can get more seeds from tree-seed dealers, arboretums, or the Glenn Dale station.☆

Cheddar IN HALF THE TIME

dairy

Several steps are completely eliminated in a new process that can be used with ordinary cheesemaking equipment

USDA researchers, who developed a short-time, labor-saving way to make Cheddar cheese in 1953, have improved and adapted the process for use with conventional equipment.

The method was developed by ARS dairy technologists H. E. Walter, A. M. Sadler, J. P. Malkames, and C. D. Mitchell at the Agricultural Research Center, Beltsville, Md. (AGR. RES., Apr.–May 1953, p. 13).

Originally, the process reduced by fully half the usual 6 to 7 hours required for making this cheese.

Now as modified for adaption to commercial equipment, and after thorough pilot-plant testing, the method is ready for use by industry.

Timesaving under this method is accomplished in 3 ways: (1) Using 2 cheese cultures rather than 1; (2) hooping the curd at 110° F. instead of about 90° F.; and (3) eliminating several steps in later operations.

Of the two starters used, one is the conventional Cheddar-cheese lactic starter. The other culture is a lactic-acid-forming streptococcus that is tolerant to heat and salt.

Both starters grow and produce acid until the curd is salted at 100° F. and hooped at 110° F. The salt- and-heat-tolerant starter continues to grow and form needed acid as the curd is hooped and pressed. This makes possible a great reduction in manufacturing time between adding starter to the milk and hooping the curd. With conventional starters, most of the acid must be formed in the vat before the curd is salted.

Making Cheddar formerly took about 7 hours. Steps, after pasteurizing and cooling milk, included adding starter, ripening, adding rennet and color, cutting curd, cooking, draining whey, packing, cheddaring, milling, pressing, and dressing. On the basis of pilot-plant tests, processes such as ripening, packing, cheddaring, and milling have been eliminated. This saves almost 3¼ hours and much hand labor. An additional 45 minutes are saved from salting through dressing and final pressing.

This means that modern factories, with little change in hooping equipment, can make 2 batches of cheese rather than 1 in an 8-hour day.

Cheese made by the new method may be cured under the same conditions used for cheese made by conventional methods, but the new-way Cheddar ripens and develops flavor faster.

This cheese has close texture, excellent body, few mechanical openings. It develops good, mild flavor in 2 to 3 months at 55° F. Hooping in salted whey rather than salted water gives slightly more flavor.☆

MAKING CHEDDER CHEESE

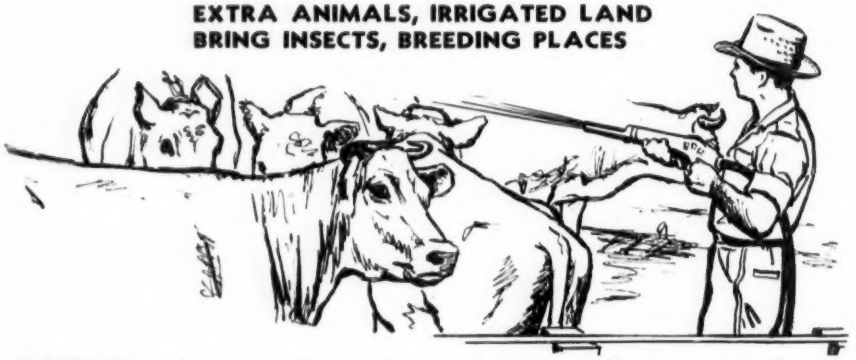
STEPS	OLD PROCESS	NEW PROCESS
ADDING STARTER		
RIPENING THE MILK	1 Hour	✗ 5 Min.
ADDING RENNET AND COLOR		
CUTTING CURD		
COOKING	2¼ Hours	2¼ Hours
DRAINING WHEY		
PACKING		✗
CHEDDARING	2¼ Hours	✗
MILLING		✗
SALTING		
HOOPING		
FIRST PRESSING	1½ Hours	¾ Hours
DRESSING, FINAL PRESSING		
TOTAL TIME	7 HOURS	3 HOURS 5 MIN.

✗ STEPS ELIMINATED

livestock

More Livestock . . . More Insect Pests

EXTRA ANIMALS, IRRIGATED LAND BRING INSECTS, BREEDING PLACES



CONTROL of insects that make farm animals miserable is an ever-increasing problem for research.

Fully 400 different insects attack livestock in this country at one time or another. Collectively, they are costing growers an estimated $500 million or more each year. Among some 50 kinds listed as highly obnoxious are those that bite, burrow, and suck blood, thereby spreading disease and even death. Worse, some of these insects are carriers of diseases affecting man as well as animals.

USDA entomologist A. W. Lindquist points out two major methods of controlling insect pests of livestock. One is by destroying their breeding places either through sanitation or use of insecticides. The second is by spraying or dipping animals with insecticides to destroy insects that spend all or a part of their lives on animal hosts. Against biting flies, sprays are also used as protectants or repellants, but do not kill.

The problem of control is growing for two reasons: (1) A countrywide increase in livestock to provide meat for our rapidly expanding population; (2) an increase in irrigated pasture and crop lands to provide feed for increasing livestock numbers.

Irrigation ditches and flooded lands offer excellent breeding places for mosquitoes and biting gnats. Many insects are encouraged by the moistness of irrigated pastures.

Mosquitoes are vectors of equine encephalomyelitis, cause of high mortality in horses, and carry a similar virus to man. They spread fowl pox to poultry and, together with horseflies, deerflies, and ticks, transmit anaplasmosis to cattle. Blue tongue, relatively new disease of sheep in this country, is carried by biting gnats or sand flies. Anthrax, an acute disease that can affect all livestock and man, has its greatest incidence in fly season. Houseflies, because of their filthy habits, are suspected of carrying disease from sick to healthy animals.

Adding to the list are biting and bloodsucking arthropods such as lice, fleas, ticks, and mites. Screwworms, cattle grubs (see p. 15), and horse and sheep bots are important enemies of livestock. They cause vitality loss that is reflected in subnormal gains, low milk production, loss of weight, and even death in some instances.

Recommended control methods rely heavily on the use of insecticides in sprays and dips and on drainage of standing water from irrigated lands to prevent them from becoming breeding and hatching places for insects, particularly mosquitoes. Water management is highly important in preventing mosquitoes from breeding in irrigated areas. DDT and similar insecticides must be spread over water areas to destroy the larvae.

Several insecticides—either sprayed or used as dips—provide good control of hornflies, lice, and ticks. DDT, lindane, methoxychlor, TDE, and toxaphene are recommended for beef-cattle sprays to control hornflies. For lice on cattle, sheep, or goats, the same chemicals, and also chlordane, make effective sprays. For hornflies on dairy cattle, however, methoxychlor, synergized pyrethrins or allethrins, and the thiocyanites are best; that's because most of the chlorinated hydrocarbon insecticides are secreted in the milk and may be hazardous to humans.

Lindane, methoxychlor, and synergized pyrethrins and allethrins are recommended for control of lice on dairy cattle. Sprays or dips of toxaphene formulations, and mixtures of toxaphene and lindane, or of DDT and lindane, afford effective control of ticks on beef cattle. Protectant insecticides such as synergized pyrethrins and allethrins give good results as cattle sprays against mosquitoes, stable flies, and deer flies. But researchers are continuing to look for more effective materials.

The most spectacular control method yet devised by science is the use of radioactive cobalt rays to sterilize male flies of the screwworm (AGR. RES., Oct. 1954, p. 8). Pilot research by USDA entomologists on the island of Curacao has shown that the screwworn population can be eradicated by release of sterilized male flies. As a practical means of eradication or control of screwworms in the Southeastern States, however, the method presents cost and other problems that have not yet been overcome.☆

eating more beef

■ IN OUR FATHERS' DAY, "eating high on the hog" meant living well. Today we're living better than ever, but with increased emphasis on beef.

USDA studies show that one of the features of our changing dietary pattern has been a long-term trend toward more beef—and consequently more red meat—in the national diet.

Economist E. E. Miller, of the Agricultural Marketing Service, points out that our appetite for pork apparently is leveling off, although we haven't lost our taste for it. We ate 66 pounds of pork per capita last year—about average for the postwar years and almost exactly the amount we ate 25 years ago. But we ate 81 pounds of beef. For the third successive year, we ate more beef than pork. That's something new.

Consumers showed a preference for beef in another way—by paying more per pound than for pork at a time when beef was more plentiful than ever. People discounted pork prices by nearly a fourth, compared with the price they willingly paid for choice-grade beef. That's somewhat more disparity than in 1954 and helps explain the drop in hog prices.

For the past 8 years, consumers have spent more total dollars for beef than for pork, although they bought more pounds of pork than beef in 5 of those years. Nearly 3 percent of our consumer income went for beef in each of those years, but expenditures for pork declined from 3 percent of income in 1947 to less than 2 percent last year. Consumers were spending some of their income gain for the meat of their choice, beef, but relatively little of it for pork.

Consumers' expenditures have held up better for lean pork cuts than for fat cuts. This shows up in comparative price trends. Early in the century, pork plates and jowls (fat cuts) sold for about 40 percent less than the leaner hams and loins, but since World War II have sold for 65 to 80 percent less. Miller attributes this to our changed way of life.

Fifty years ago much of the population did strenuous work and ate fat meats for energy. Technology has been taking exertion out of labor, channeling the labor force into easy occupations, shortening the work day, and increasing leisure time for all. Growth and centralization of industry attracted much of our rural and small-town population to the more confining life of the city. Now we're a sedentary people, tending to corpulence—a nation of calorie watchers. So Miller thinks we're catering to both taste and our new needs in this continuing shift from pork to beef.

As consumers demanded leaner pork, farmers and packers have clamored for leaner hogs. ARS researchers have made considerable progress. In time there may be leaner pork in the market and possibly a pick-up in pork appetite. No one knows whether that would take demand away from beef. It could very well strengthen demand for pork while not affecting the preeminent position of beef.☆

A STEP CLOSER TO A CATTLE-GRUB SYSTEMIC

■ A NEW SYSTEMIC insecticide that killed cattle grubs outright in recent USDA tests on cattle encourages the hope that we are at last closing in on this $100-million-a-year parasite.

The new and promising insecticide is a phosphate compound called Dow ET–57. Its formal chemical name is 0,0-dimethyl-0-2,4,5 - trichlorophenyl phosphorothicate. It moves throughout the body to destroy grubs before they break the hide and appear in the back. Animal treatment is considered the only practical control in view of the parasite's breeding habits and the extensive area of infestation generally ranged over by cattle.

ARS entomologists W. S. McGregor and E. C. Bushland and veterinarian R. D. Radleff at the Kerrvill, Tex., station fed ET–57 to 5 heavily infested cattle and kept 5 other grubby ones untreated for comparison. The dosage was 100 milligrams per kilogram of animal weight—1.6 ounces for a 1,000-pound animal. The insecticide was given 2 to 5 months before grubs normally appear in a cow's back. By the usual time for their emergence, 93 grubs had come through the backs of the untreated cattle but only 4 from the treated ones—that is, 1 grub from each of 4 animals and none from the fifth.

Entomologists G. W. Eddy and A. R. Roth got 88-percent grub kill in a similar test at the Corvallis, Oreg., station. And 35 calves in a heavily infested South Dakota herd were treated after grubs started showing up in the backs, then were shipped to Kerrville for study. Even at that late date the insecticide killed all grubs so none emerged. On untreated calves, all grubs originally detected in the backs plus an average of 30 others ultimately emerged.

In passing through the animal, grubs leave a trail of damaged flesh to discard—mainly in the loin and rib cuts—and holes in the hide.☆

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OFFICIAL BUSINESS

agrisearch notes

BEEF CALVES as young as 3 to 4 months can temporarily lose weight on sparse low-calorie forage and come back to make good gains and good beef, USDA research shows.

Earlier work on identical twin-beef calves at Beltsville (AGR. RES., Mar. 1954, p. 8) showed that 6 to 12 month-old animals barely holding their weight could recover quickly and profitably when well fed. USDA scientists say, though, that calves' diets must be supplemented by sufficient proteins, minerals, and carotene to keep them healthy.

Latest results prove that animals as young as 3 months can lose weight on poor-quality forage or during a drought for 3 to 6 months, and can recover later on full feed to make economical gains and produce high-quality beef.

SPIDER MITES that survive all insecticides are passing resistance on to their offspring and will threaten crops increasingly until we find a miticide that kills all mites, say USDA researchers.

Due to mites' prolificacy and rapid regeneration cycle, a single resistant female can give rise through succeeding generations to as many as 13 million resistant progeny within a month in a warm environment.

This explains why some greenhousemen, once able to control mites with several chemicals, are having increasing infestations that can't be controlled. It's also foreboding to growers of fruits, flowers, vegetables, cotton, and some other crops where mites still are controlled.

In experiments at Beltsville, Md., ARS entomologists E. A. Taylor and F. F. Smith crossed a strain of resistant mites from Cranbury, N. J., with nonresistant strains. The Cranbury female's pair of genes for reaction to chemicals was naturally divided among the offspring, half getting one gene and half the other. Both of the pair of genes were resistance genes—each conferred full resistance and all of those offspring were resistant. This second generation had only one resistance gene paired with a nonresistance gene. So they in turn transmit only nonresistance to half of their offspring in the third generation.

The male line of descent poses a more serious problem. Males develop from unfertilized eggs and inherit one of the mother's sets of genes. In the Cranbury line, that always includes a gene for resistance to chemicals. A resistant virgin female may, therefore, mate with her male offspring and accelerate the spread of resistance in the population.

An intensive search is underway for a fully effective miticide.

THE RAMPANT spotted alfalfa aphid, which cost an estimated $5 million in the Southwest in 1954 and $13 million in California alone in 1955, is spreading.

This aphid has already cost Oklahoma $12 million this year. In southwestern Missouri a sweep of the net may catch 1,000 aphids. They're thick in New Mexico, Arizona, Utah, and Kansas, central and north Texas, and California—are damaging in several other States west of the Mississippi, and recently showed up in Florida. Fortunately, lady beetles, other predators, and insecticides are aiding in control.

The aphids suck juice, may inject poisons, causing leaves to yellow and drop. That cuts growth and generally interferes with both yield and quality of crop.

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